



# New Alternative Fuel Vehicle Emissions Data

**Kenneth J. Kelly**



National Renewable Energy Laboratory  
Golden, Colorado

Windsor Workshop on Transportation Fuels  
Windsor, Ontario, Canada  
June 11, 1997

*CENTER FOR TRANSPORTATION TECHNOLOGIES AND SYSTEMS*

Z1-B196201

U.S. Department of Energy  
Office of Technology Utilization  
Frank Mallgrave, Program Manager



*CENTER FOR TRANSPORTATION TECHNOLOGIES AND SYSTEMS*

Z1-B196202



# Outline

- NREL Emissions Testing Program
- Detailed Study Vehicles
- Test Matrix
- Test Cycles
- Results
- Conclusions
- Direction



# NREL Alternative Fuel Vehicle Emissions Test Program

- Light-Duty Vehicle Evaluation Team
- Purpose: To provide a high-quality, objective evaluation of in-use emissions from commercially available alternative fuel vehicles



## Test Status

- Tests completed (approximately)
  - 1500 FTP tests on 500 vehicles
  - 600 IM240 tests on 300 vehicles
  - 200 detailed hydrocarbon speciations on 70 vehicles
- Fuels tested: M85, M50, E85, E50, CNG, LPG, RFG  
(Note: RFG = California Phase II Certification Gasoline)



## Test Status (continued)

- Vehicles tested
  - OEM
    - Methanol FFV: Dodge Spirit, Ford Econoline, Dodge Intrepid
    - Ethanol FFV: Chevrolet Lumina, Ford Taurus
    - Dedicated CNG: Dodge B250 Van, Dodge Caravan
    - Standard gasoline: all of the above models
  - QVM
    - Bi-fuel CNG: Ford F150 Pickup, Ford Contour
    - Bi-fuel LPG: Ford F150 Pickup
  - Aftermarket conversions
    - Bifuel CNG: various models
    - Bifuel LPG: various models



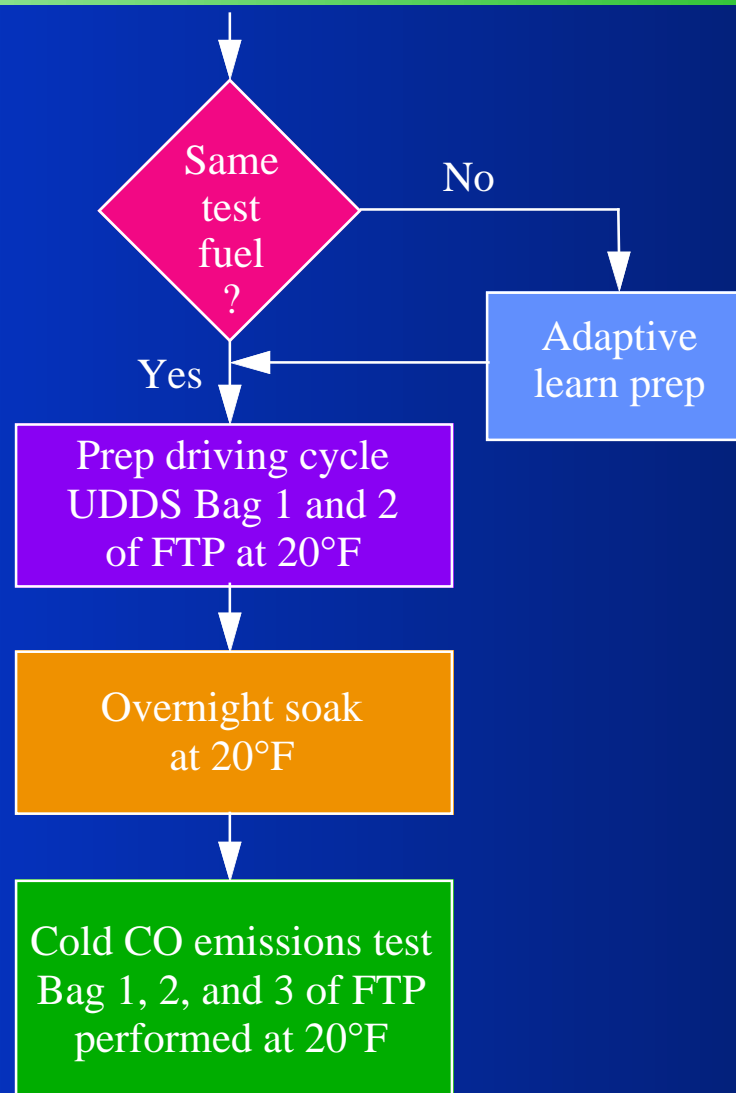
## Detailed Study Vehicles

- Purpose: Detailed study to investigate emissions impacts of alternative fuels under real-world driving conditions (outside the FTP-75 test procedures)
- Approach:
  - FTP-75 with detailed hydrocarbon speciation
  - Emissions testing according to Federal Cold CO test procedures
  - Emissions testing according to the US06 “Aggressive Driving Cycle” procedures

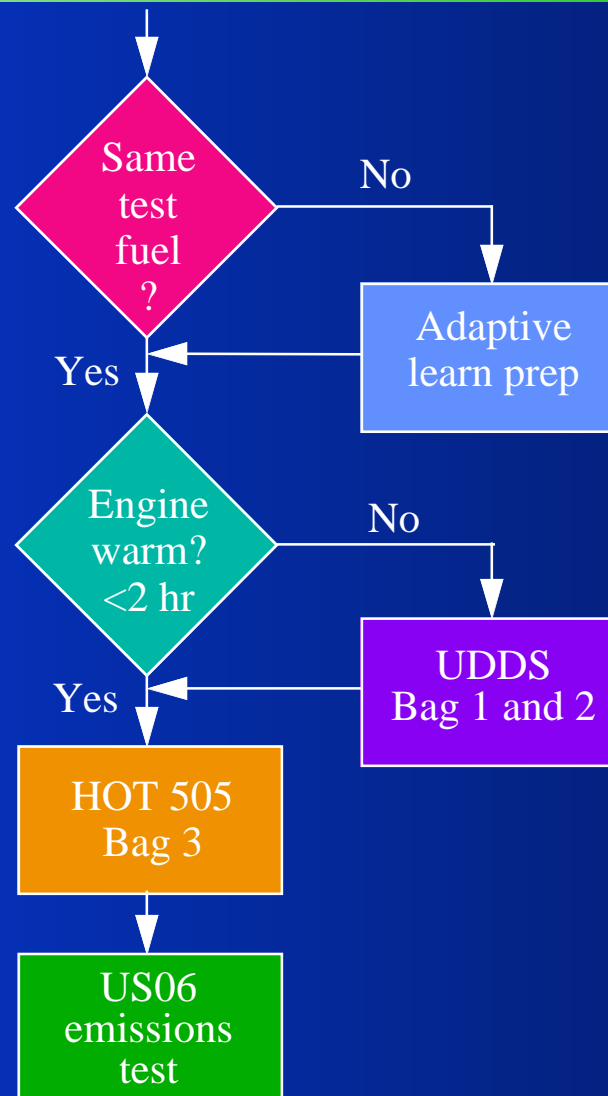
# Detailed Study Vehicle Test Matrix

Make	Model	Model Year	Vehicle Type	Test Fuel	Test Vehicles	Repeats	Total Tests
<b>Methanol FFV</b>							
Dodge	Intrepid	1995	FFV	M85	4	1	5
				RFG	4	1	5
Dodge	Intrepid	1995	Standard	RFG	4	1	5
Ford	Taurus	1995	FFV	M85	4	1	5
				RFG	4	1	5
Ford	Taurus	1995	Standard	RFG	4	1	5
<b>Ethanol FFV</b>							
Ford	Taurus	1995	FFV	E85	4	1	5
<b>Dedicated CNG</b>							
Dodge	B250 Van	1994	Dedicated	CNG	4	1	5
Dodge	B250 Van	1994	Standard	RFG	4	1	5
<b>Bi-Fuel CNG</b>							
Ford	Contour	1996	QVM	CNG	4	1	5
				RFG	4	1	5
Ford	F150 Pickup	1996	QVM	CNG	4	1	5
				RFG	4	1	5
<b>Totals</b>					<b>52</b>	<b>13</b>	<b>65</b>

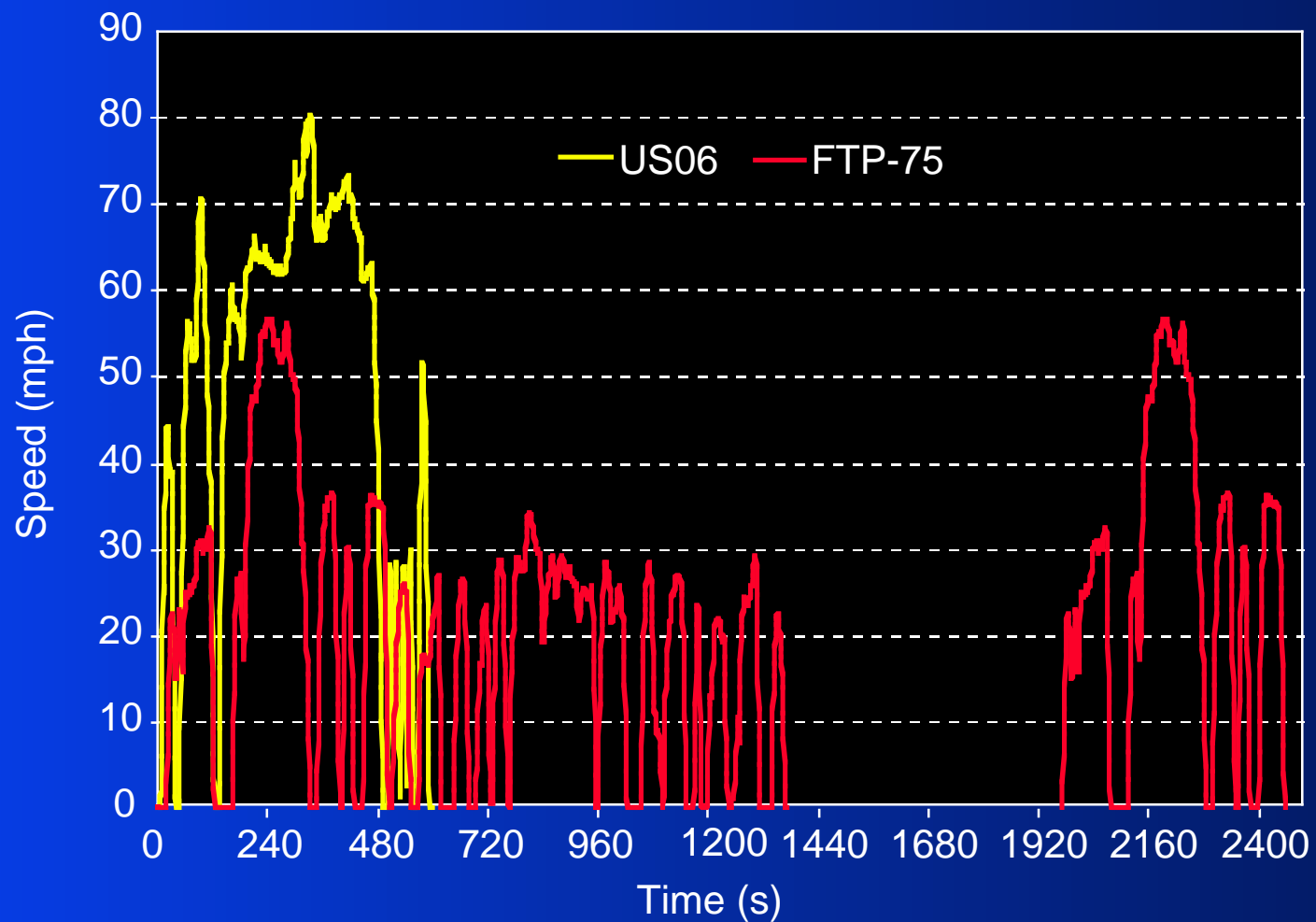
# Cold CO Test Procedure



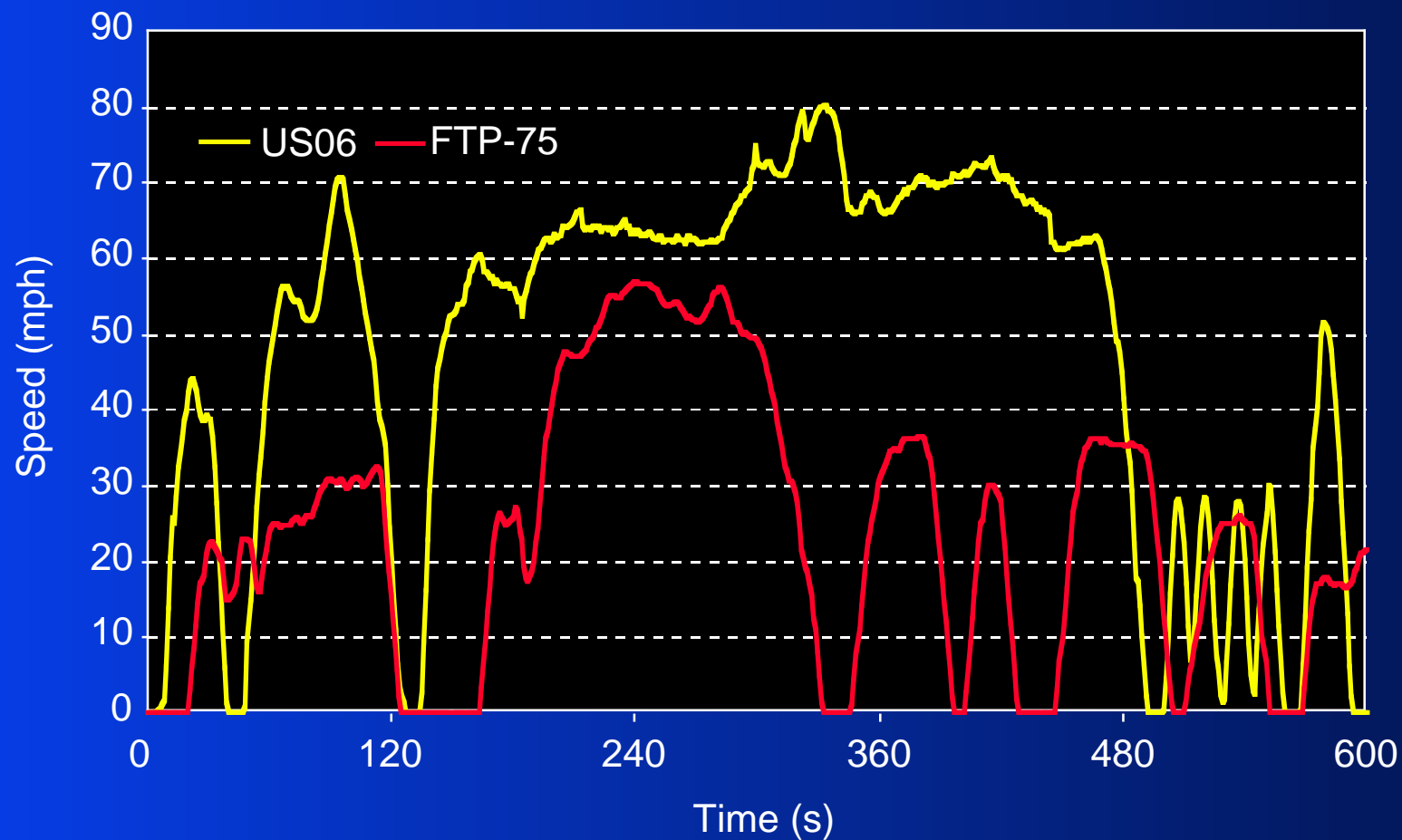
# US06 Test Procedure



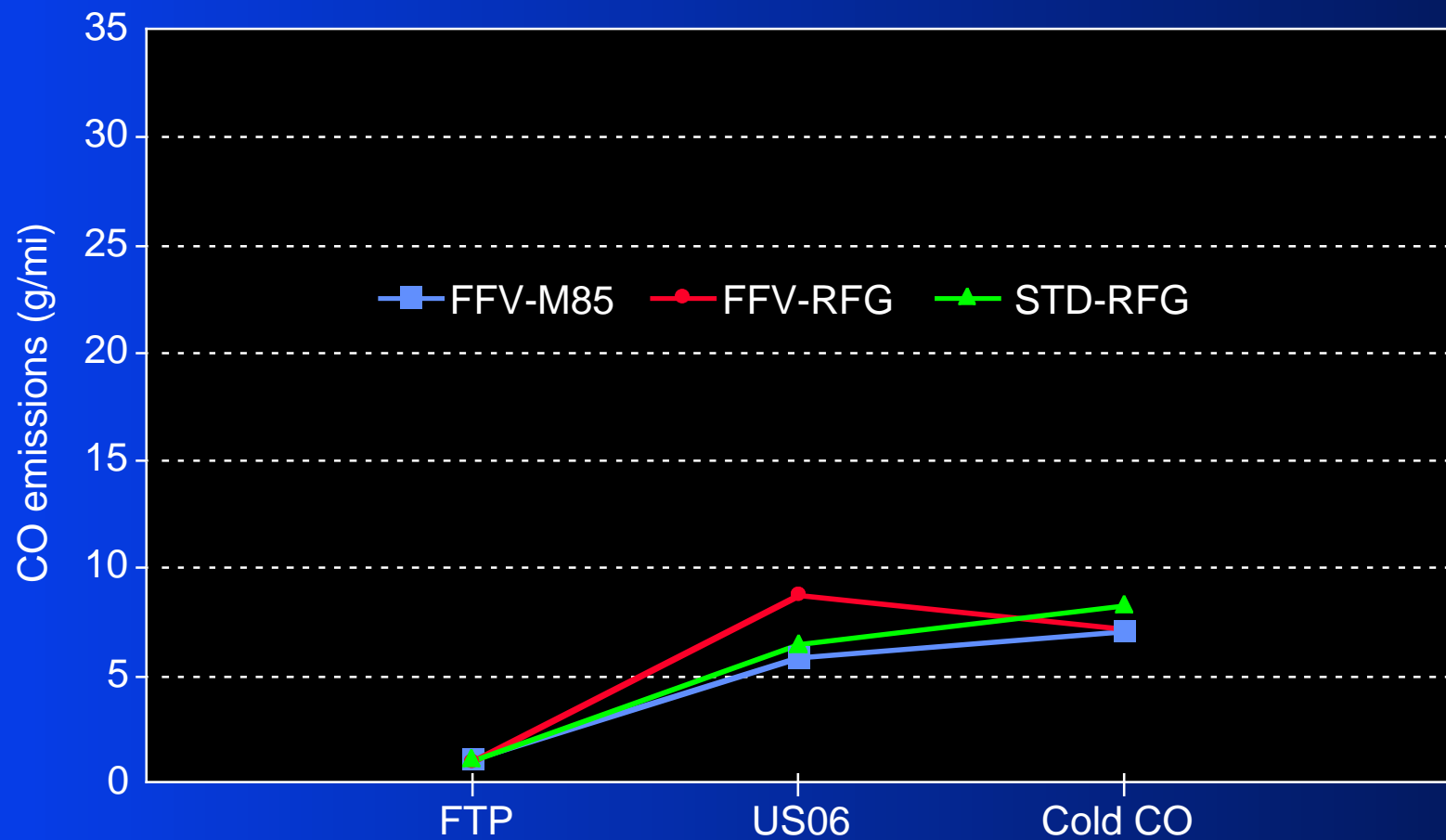
# US06 Aggressive Driving and FTP-75 Driving Cycles



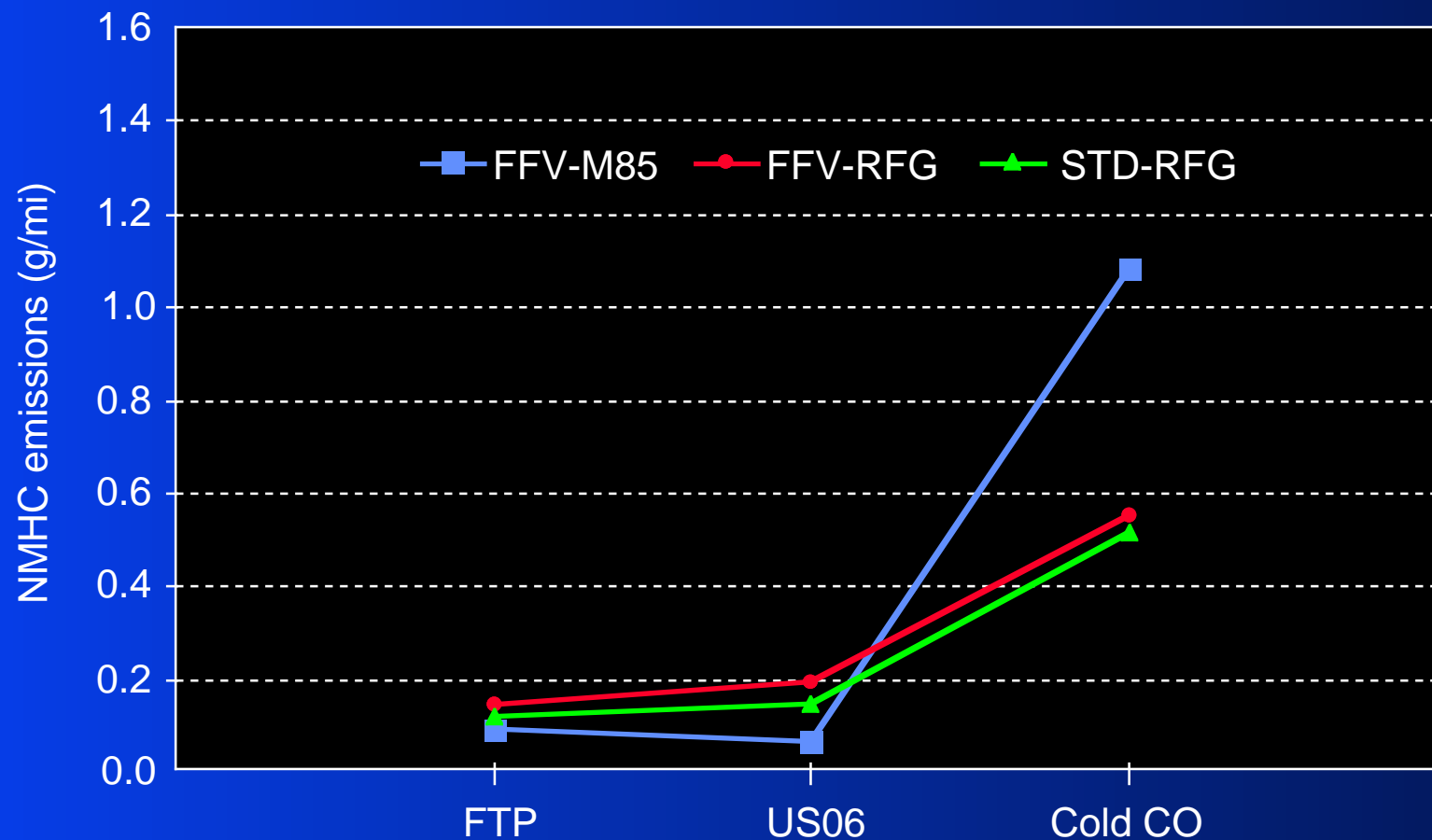
# US06 and 600 Seconds of FTP-75



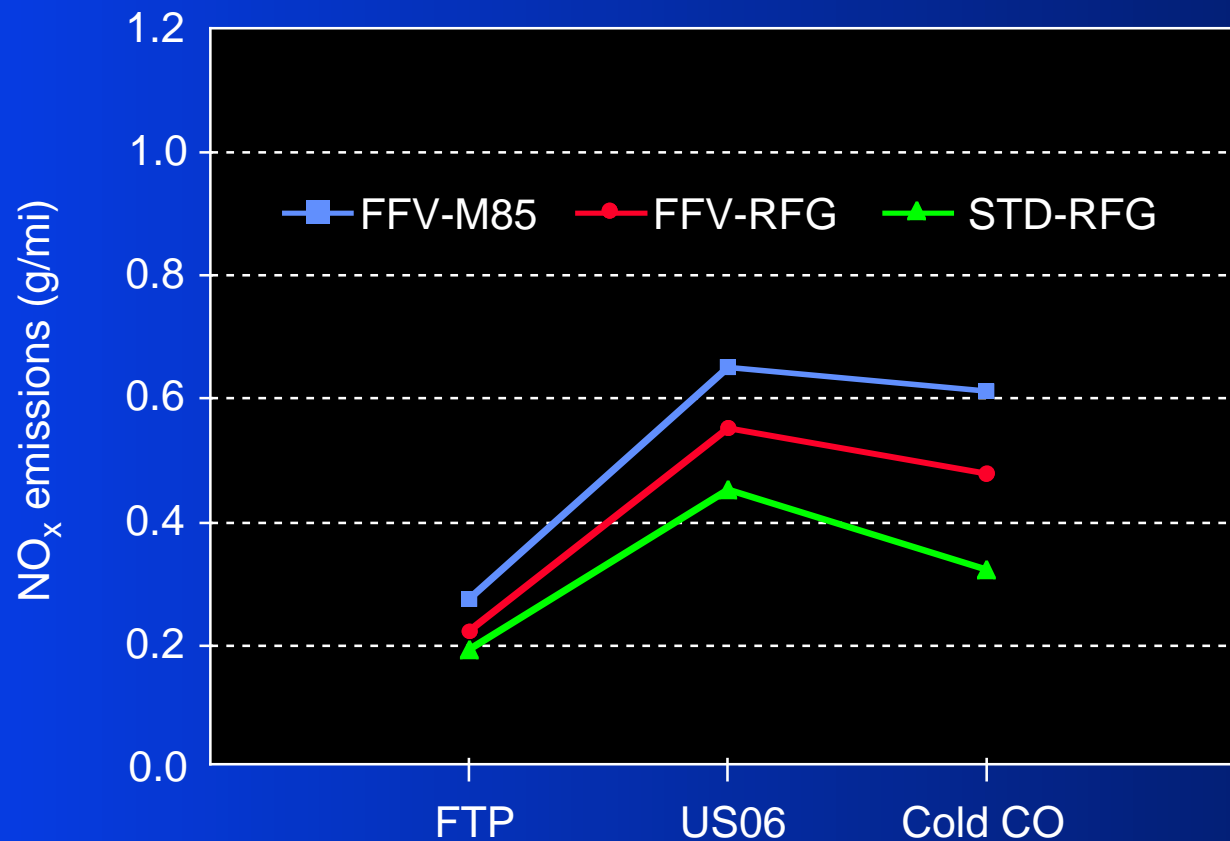
# Dodge Intrepid—Carbon Monoxide



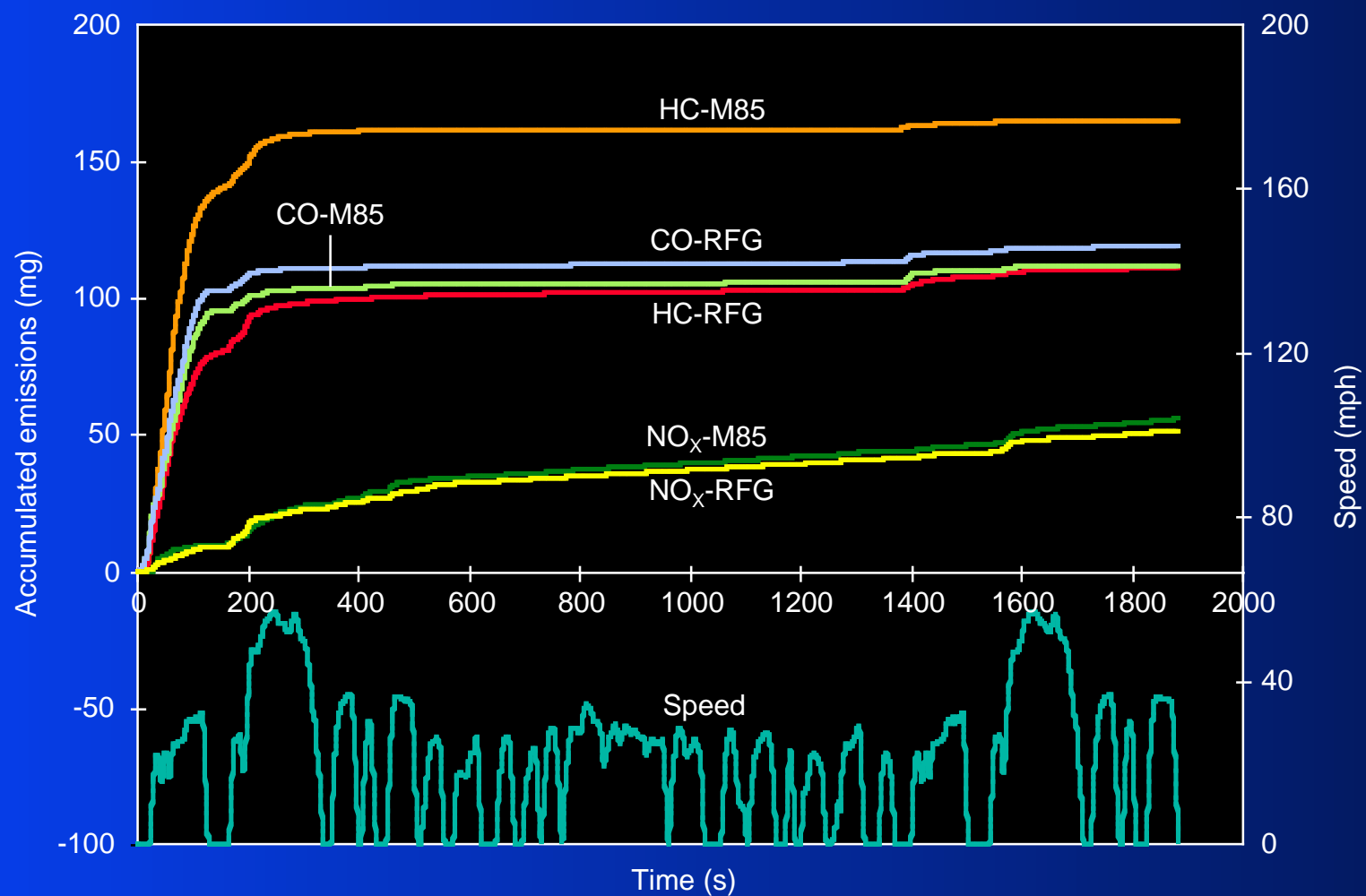
# Dodge Intrepid—Non-Methane Hydrocarbon Equivalent



# Dodge Intrepid—Oxides of Nitrogen



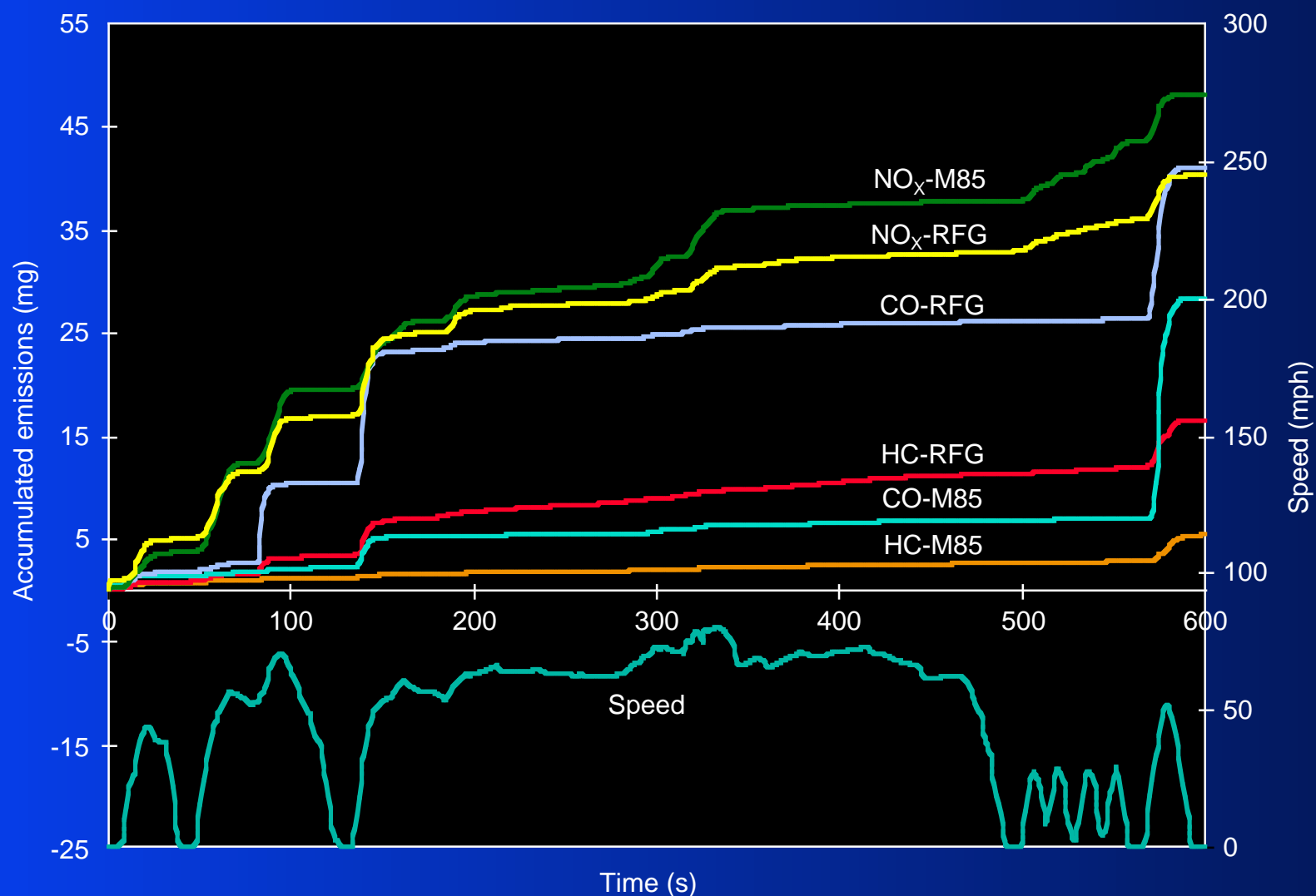
# Dodge Intrepid—M85-FFV Cold CO Continuous Emissions



CENTER FOR TRANSPORTATION TECHNOLOGIES AND SYSTEMS

Z1-B196219

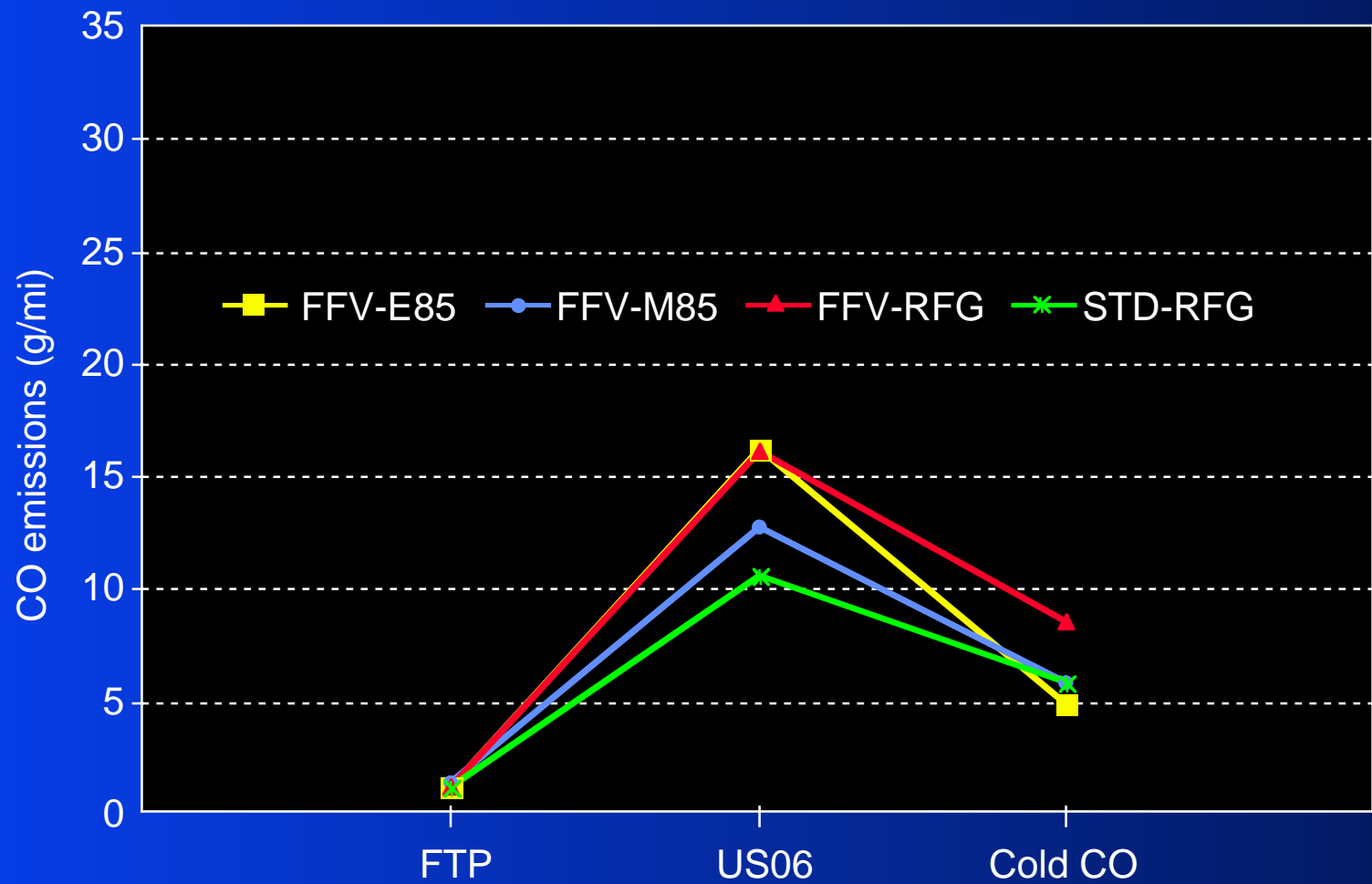
# Dodge Intrepid—M85-FFV US06 Continuous Emissions



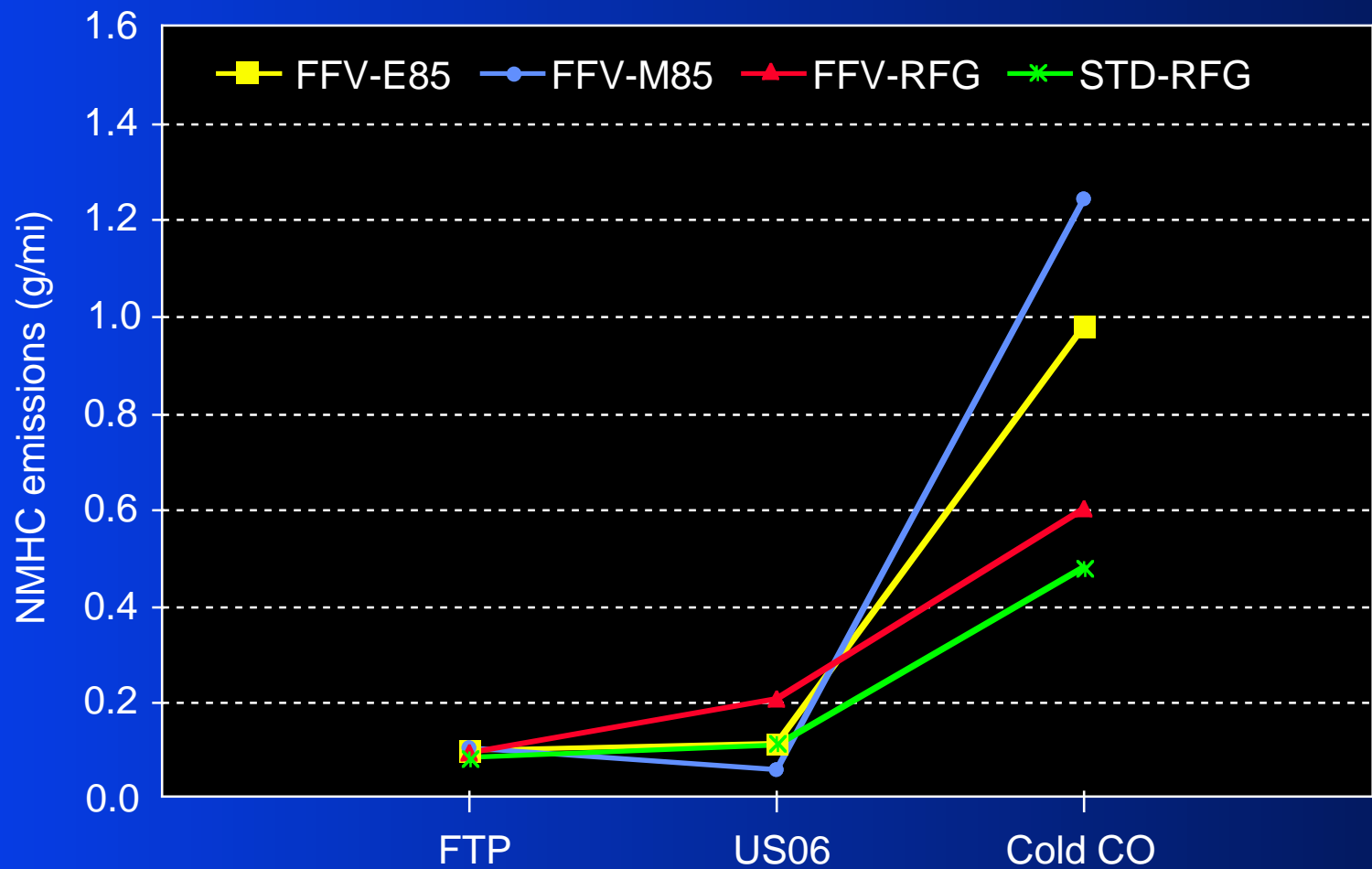
*CENTER FOR TRANSPORTATION TECHNOLOGIES AND SYSTEMS*

Z1-B196220

# Ford Taurus—Carbon Monoxide



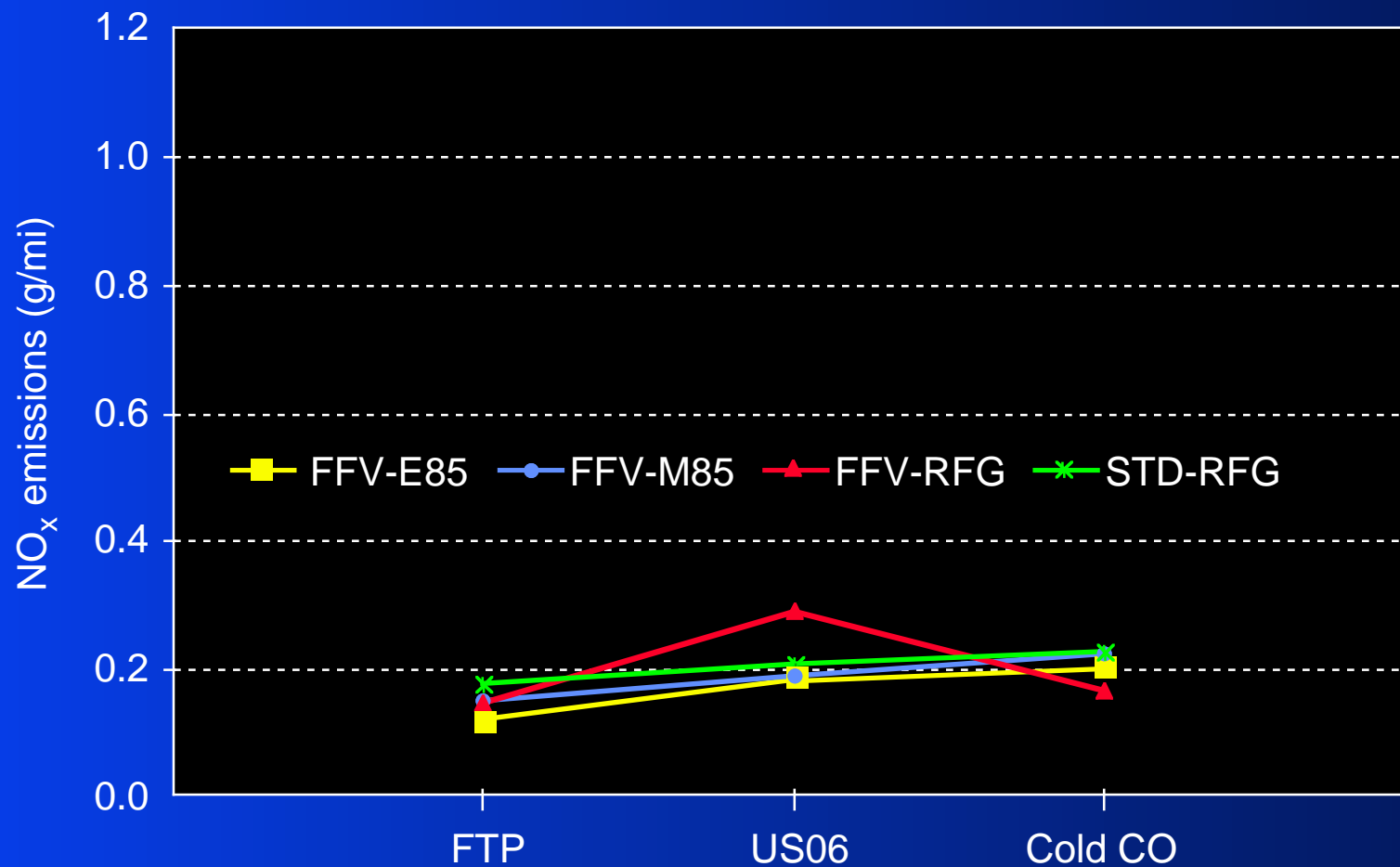
# Ford Taurus—Non-Methane Hydrocarbon Equivalent



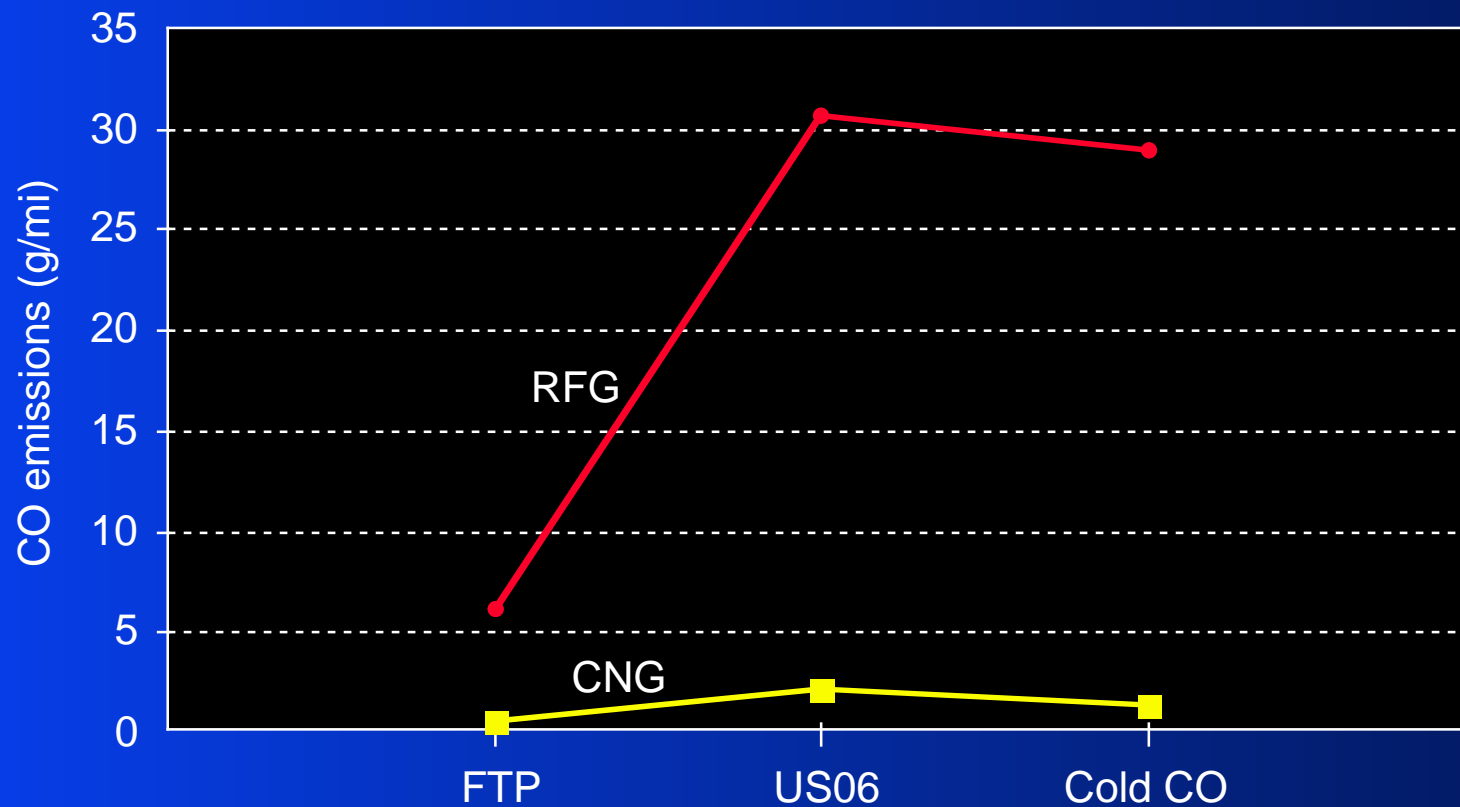
*CENTER FOR TRANSPORTATION TECHNOLOGIES AND SYSTEMS*

Z1-B196214

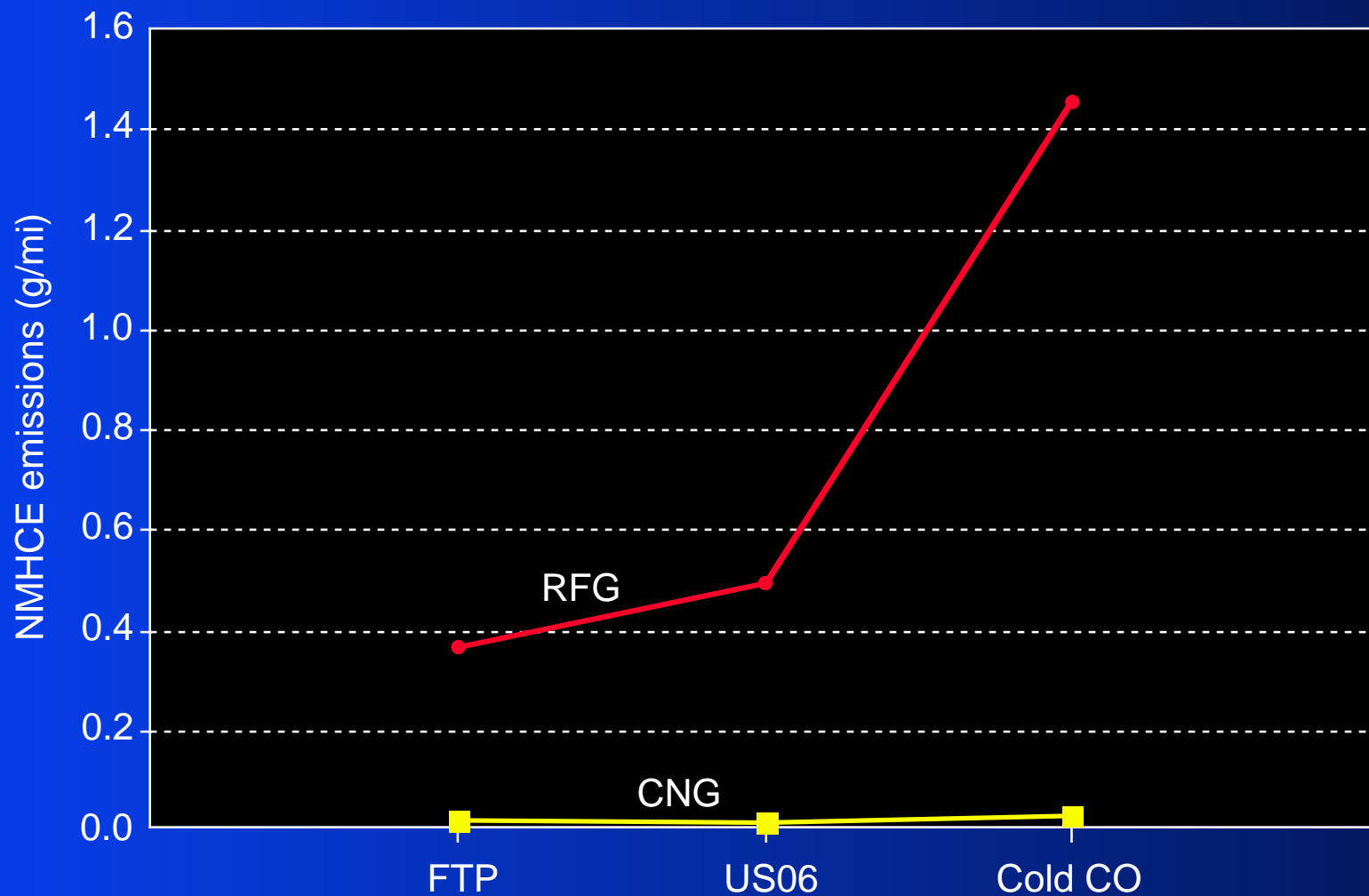
# Ford Taurus—Oxides of Nitrogen



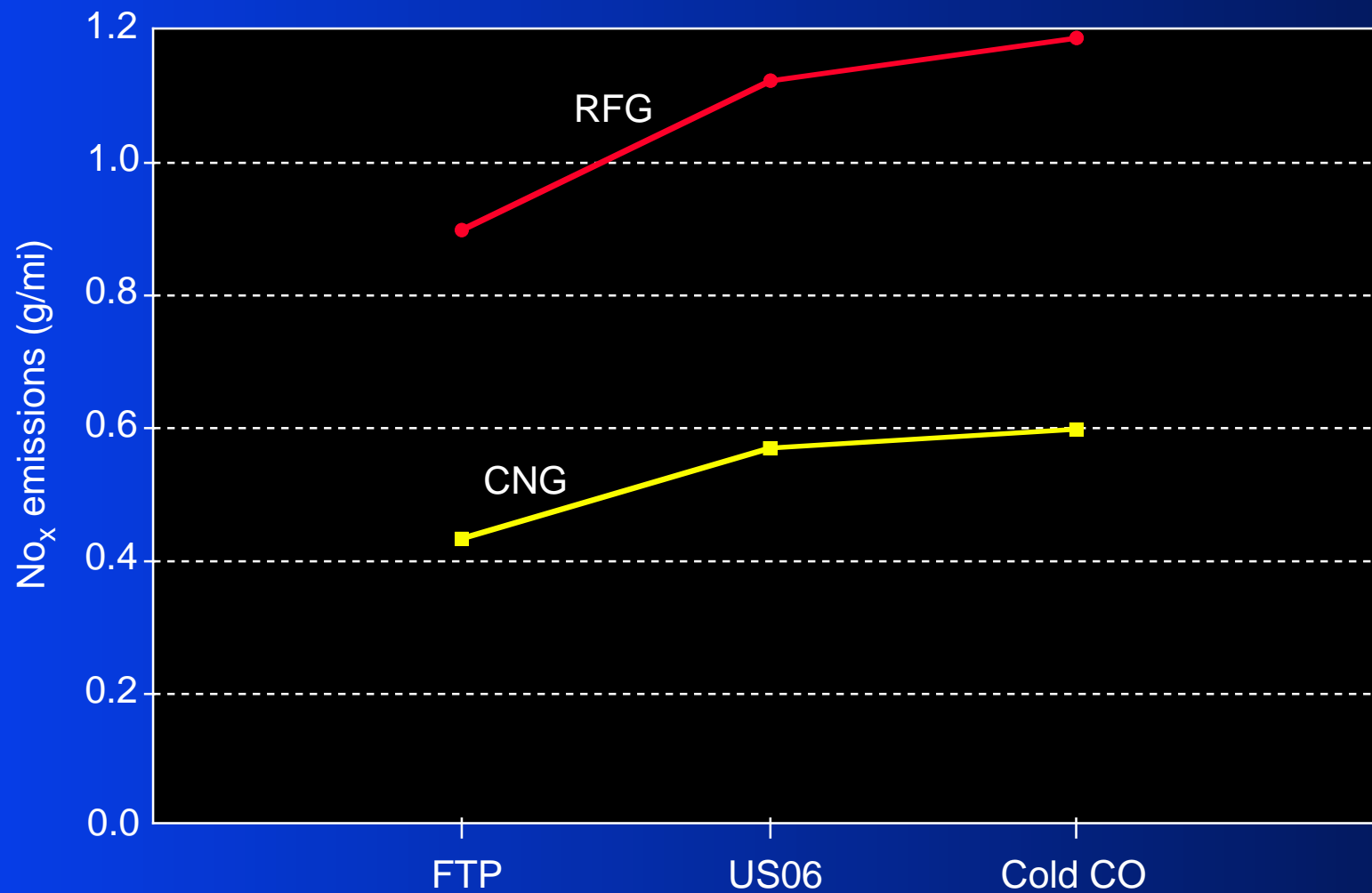
# Dodge B250 Van—Carbon Monoxide



# Dodge B250 Van—Non-Methane Hydrocarbon Equivalent



# Dodge B250 Van—Oxides of Nitrogen





## Conclusions

### CNG

- OEM dedicated-CNG vehicle resistant to changes in driving cycle (i.e., clear emissions benefits compared to standard gasoline vehicle on all three driving cycles—FTP, US06, and Cold CO)

### Alcohol Fuels

- Tended to perform relatively well on US06 driving cycle
  - Reduced NMHC and CO
  - Relative NO<sub>x</sub> levels similar to FTP
- Exhibited increased NMHC on Cold CO tests



## Program Direction

### 1997

- Complete testing on first round of detailed study vehicles
  - Bi-fuel QVM Ford F150 Pickups and Ford Contours
- Complete statistical analysis and publication of all results

### 1998

- Additional detailed study vehicle testing
  - Later model OEM CNG vehicle
  - 2nd round of testing to verify results
  - Addition of particulate matter study to detailed study vehicle program
- High-mileage focus fleet



# Acknowledgment

## Automotive Testing Laboratories

Wendy Clark and Walt Dudek

*Winner of Small Business Administration's Small  
Business Subcontractor of the Year for Region 5*